Appendix 1. Summary of Vendor answer analysis.

		ROLLS ROYCE: SMR	GE HITACHI: BWRX-300	EDF: NUWARD	WESTINGHOUSE: LFR	FALCON (ANSALDO NUCLEAR/ENEA/RATEN): ALFRED	VTT: LDR 50
1	Key Features for competitiveness?	• Factory fabrication, qualification and in-factory commissioning of modules. • standard PWR technology. • Use of commodity based volume procurement • Modular plant assembly • Use of commercial products enabled via Graded Approach • Digital twin technology	• Utilizing proven, low-enriched fuel • Closed loop cooling in the event of accident • Steel concrete composite panels and modularized factory construction • Utilizing industrial standard items • Local industry involvement • Leveraging shaft sinking techniques • Deeply embedded reactor building to facilitate seismic qualification	• Modular design and manufacturing • Standard design and series effect • Simplification of overall design • Harmonised and adapted design for worldwide deployment • Strategic financing	• Optimisation of levelized cost relative to reduced scale and increased affordability • Fewer safety related components and small nuclear-related plant volume (No need for traditional nuclear containment) • ~50% of plant systems eliminated or reduced • High efficiency and power density with air-cooled heat rejection • Optional integral energy storage and non-reactor based load following • Direct-to-cask refueling • High implementation of modularization	• Simplified safety features and high safety standards. • High potential energy per unit power and compact coolant system. • Modularity and transportability • Advanced manufacturing techniques	• Low investment cost through small size and optimized design for low temp. heat production. • simplification of systems, fewer components, faster implementation, and less risk with project schedule. • Modularization of key nuclear components and manufacturing. • Specializing on heat energy market segment
2	Series effect; How many modules are you estimating to reach the optimal cost?	Number of units is not the most relevant economic factor: the design approach focuses on modularization of the entire power plant ,factory fabrication and the associated learning curve.	Each power block is 300 MWe and multiple units can be built on the same site for NOAK benefits.	Large-scale series production of modules, with series effects sought in factories and on site through standardized design and modular approach. A mid to long-term visibility on a pipeline of projects would be beneficial in order to achieve target NOAK cost as fast as possible.	Projected cost savings for the LFR do not go beyond the typical savings seen for large plants. The projected NOAK costs are representative of costs seen around the 8th unit. While further efficiencies are possible beyond this number, they are not credited in the business model.	The learning curve advantages for commercial reactors are accounted for, with benefits similar to large reactors seen around the 8th to 10th reactor. The smaller size allows for faster cost optimization through deployment of multiple units in limited geographical areas.	The aim is to have ~50 MW modules in a heating plant, optimal size depending on the district heating network. Initial assessment suggests 100-200 MW plants as a fair compromise from an OPEX standpoint. 25 modules would enable significant cost reductions.
3	Special Components that are innovative and critical in terms of availability and quality requirements? Estimation of the percentage of the plant's overnight capital cost that would be associated to these components?	Special components avoided where practical. Limited number of special components within the primary circuit which could become critical path if not managed accordingly.	The BWRX-300 uses proven components and materials as much as possible. The materials of the reactor pressure vessel and internals are already in use.	• Integrated Reactor Pressure Vessel (RPV) that incorporates the Compact Steam Generators (CSGs) and Control Rod Drive Mechanism (CRDM) into a single pressurized component. • Unit containment located in a water-filled pool. • Passive safety cooling system (residual heat removal system, RRP) that activates automatically and operates for an extended period without human intervention.	Special components represent an estimated 6% of the overnight capital cost of the plant (without fuel). For example: • Reactor vessel and lid • Guard vessel • Reactor coolant pumps • Steam generators / Primary HXs • Reactor internals • Control rod drive mechanisms • Various sensors and filtration media	ALFRED's design uses high-tech components, with plans to introduce more advanced ones later during demonstration program. Achieving top competitiveness requires high coolant temperatures, which increase the corrosiveness of lead. The challenge is developing protective techniques and materials for special components. Special components approximately 10% of the overnight capital cost.	Major components are pressure vessels (however, compared to the PWR system pressure of 15 MPa the estimated system pressure in LDR-50 is well below 1 MPa), primary heat exchangers, and in-vessel control rod drive mechanisms. As there is no turbine island, the relative fraction of reactor module cost is higher than usual for the whole plant, working estimate has been 50%.
3 b	Fraction of the plant's overnight capital cost typically associated with safety-related components (Safety Class 1-2-3)?"	Graded approach to quality, fraction of safety class components not available at this stage	Safety Class 1 SSCs represents 20% to 30% of the overnight capital cost.	Not specified, see above.	Because of inherent safety features , safety-specific components (i.e., ones with no commercial purpose) are minimal and estimated to be <1% of overnight cost.	Safety-specific components other than the Special components have a minimal contribution.	See above.
4	Supply chain capability and capacity of the critical components? Issues with the availability of raw materials or semi-finished parts from Europe?	Risk is in achieving capacity requirements, not capability. Suppliers with regulated environment experience will be considered, not restricted to nuclear. Fluctuations in availability of raw materials and capacity anticipated, with mitigations in place.	The first few BWRX-300s projects can be implemented with the existing supply chain plus what is being developed for the lead BWRX-300 in Canada. Additionally, the design utilizes a maximum amount of "catalog components" which enlarges the supply chain in multiple regions to balance supply and demand.	The objective is to have a robust and diversified European supply chain. The possibility to enlarge the pool of suppliers to those operating in non-nuclear domains is being carefully assessed.	All components can either be procured from European suppliers The primary heat exchangers (hybrid micro-channel heat exchangers) are likely the component with fewest suppliers. Overall, the supply chain is well supported in Europe, thanks to the numerous lead-cooled reactor technology developments	The research infrastructures built by the FALCON ("Fostering Alfred Construction") members in Romania, Italy and UK enabled establishing synergy with key suppliers for prototypical and industrial standard components. Design and construction are sufficiently robust based on nuclear design codes. Fabricability and transportability of large components assessed with local nuclear component manufacturers in Italy and Romania.	Given the low operating pressures it is currently being discussed the potential for suppliers other than common RPV manufacturers. The required amount of corrosion-resistant metals is significantly lower than in high pressure nuclear reactors.
5	Manufacturing time of the special components? Impact on the critical path on the plant construction? Assumptions to build them upfront?	No particular effect; The RR SMR design purposefully avoids the use of special components of this nature.	The construction duration for the first BWRX-300 will be approx. 3 years. Several components including the reactor pressure vessel have to be ordered prior to start of construction to achieve the overall schedule.	Too early to be defined	The longest lead components are likely to be the vessel, guard vessel, lid, and internals. These would be ordered during pre-construction activities and would not pose a significant threat to critical path.	Except for few forgings reactor vessel and cover, special components are not expected to limit the schedule. Orders related to semi-finished materials to be machined into high-quality components will require to be placed at the early stages of the construction.	Reactor pressure vessel should not be a long lead time item as no heavy forging is envisaged. As the heat is transferred via exchangers and there are no turbines, there would not be long lead time items on the secondary side either.
6	Need for dedicated factories?	RR SMR will have dedicated factories for the production and assembly of all the modules required No bespoke factories for special components that are part of the modules are required.	Dedicated factories are not required. However, cooperation with supply chain partners is relied to bring additional capacity on-line The design process maximizes the use of serially produced industrial standard components.	This is entirely possible, but too early to be assessed at this stage. The ability to use existing industrial capacities within EDF and partners will largely derisk the delivery of the first NUWARD SMR power plants in Europe.	The most important dedicated factory required is a fuel manufacturing facility capable to produce the fuel(s) of interest to LFR, i.e. either HALEU UO2 or MOX.	Presently, dedicated factories are not expected to be necessary. Early engagement with manufacturers within the FALCON experimental programme would allow them to plan in advance investments to upgrade their manufacturing capabilities and capacity.	Most likely a dedicated production line for some components would be foreseen, compliant with nuclear QA requirements
7	Utilisation of modularisation?	Yes, the entire RR SMR plant (including nuclear island, turbine island, balance of plant, cooling system etc.) is intended to be modularised.	Yes, GEH and its Global Alliance Partner Hitachi GE Nuclear Energy (HGNE) have extensive experience in modularization in the nuclear field with the ABWR being optimally modularized in multiple builds.	Yes, the goal is to manufacture a significant part of the systems at the factory and assemble or pre-test them on skids. Modulariation is also considered for civil construction.	Yes, the LFR will use both mechanical modules and structural modules for the whole plant. Moreover, LFR's building structure will be designed to be comprised of only a small number of different structural module elements that are repeated.This represents Westinghouse's third generation of modularization design technology.	FALCON is considering mechanical, electrical and structural modules as a key to shorten and ensure certainty on construction time and costs. This will apply to all parts of the nuclear plant.	Yes, modularization of the integral nuclear vessel is envisaged. Possibly also modularization of reactor island structures.
8	Other cost reduction features?	Wide range of environmental conditions and input data for internal and external hazards to maximise the opportunity for deployment of the standard product. The design includes use of an aseismic bearing , further minimising the risk of the need for re-design.	The BWRX-300 is designed to meet various regulations and site conditions. The standard design accommodates both 50 and 60 Hz equipment and can handle various soil conditions and external hazards.	The NUWARD™ design is being standardized to facilitate acceptance and licensing in various countries. The Joint Early Review of NUWARD SMR by French, Czech and Finnish safety authorities is a key enabler to achieve a more streamlined approach towards licensing in multiple countries. In addition the use of serially produced standard equipment simplifies procurement, manufacturing, and maintenance processes while ensuring good operating conditions and ageing management.	The use of air-cooled condensing as a default for power conversion heat rejection, is anticipated to alleviate some of the site-to-site challenges. This will also make a much larger number of sites applicable to the plant	Site conditions for ALFRED have been derived from European standards (Eurocode). Moreover, in order to increase the number of candidate site, as well as to reduce site specific preparatory works, an air-cooled condensing option has been recently introduced in the ALFRED balance of plant design for the heat rejection.	The design should take advantage of district heating plant systems in current use. Potentially prefabricated large structural components would facilitate standard construction.

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9	What kind of fuel and fuel supply arrangements are you considering? Do you plan to address supply chain challenges of HALEU (High Assay Low Enriched Uranium)?	Industry-standard UO2 fuel to minimise regulatory risk and to maximise the use of existing fuel supply chains and spent fuel waste management infrastructure. RR SMR do recognise the potential benefits that new fuel types may offer once these are licenced and in production.	Standard; the BWRX-300 utilizes GNF2 fuel that is low enriched, less than 5% U-235, and has more than 25,000 bundles successfully utilized in reactors to date.	Standard; The fuel used for NUWARD™ is of same type to that used in the existing PWR fleet, it will differ only in length, being shorter. The fuel cycle, both upstream and downstream, is already mastered and industrialised.	Staged approach, starting with high-maturity UO2 fuel in the first phase, potentially followed by lower-maturity but higher anticipated performance fuel (uranium nitride). In spite of multiple fuels being considered, the LFR core/vessel geometry is designed to be the same in order to eliminate/minimize changes in internals associated with transition from one fuel to another. HALEU supply is a clear gap in the market. Westinghouse interest for enrichments > 5% is not limited to LFR, as it also includes LWRs (however only between 5-10%).	Mixed Oxide Fuel; fuel cycle sustainability with MOX selected as the candidate fuel due to past experience in its fabrication and recycling. The re-establishment of the MOX supply chain is being addressed by ESNII as part of SNETP, while alternative fuels (such as U/PuN) are being considered for longer-term improvements	Truncated PWR fuel (approx. 1 m of active length, <5% fuel enrichment). No need for HALEU.
10	Standardization of supply/suppliers? Your view to standardization vs usage of the local supply chains?	Use of multiple suppliers for similar components to add capacity if required. The mitigation of a single or sole source supply options is a key aspect of the RR SMR supply chain strategy.	Standardizing layout, components, and structures are utilized to reduce costs and achieve NOAK efficiencies quickly. Market demand makes using a single set of suppliers impractical other than the first few BWRX-300s; therefore, GE-Hitachi is developing multiple suppliers for each component on a global basis. Local supply will play an important role and common specifications and drawings will help ensure standardization.	Depending on the industrial strategy and on industry maturity across Europe, considerable parts of the power plant will be manufactured by different suppliers.National industrial strategy will need to be replaced by regional industrial strategy.	Westinghouse experience has shown that it is rarely possible to sole-source components, even on standardized plants. Local content is often required. Tying design to one specific component model is not common outside of nuclear/nuclear safety systems.	Standardization will be extended to the conventional plant while maintaining flexibility for design changes. Single sourcing suppliers may be advantageous with early engagements for regional markets. Balancing supplier diversification and volume will depend on regional deployment opportunities. Maximizing standardization will enable supplier diversification and cost optimization from serial production.	Supply chain localization would not be relevant for smaller thermal MW plants, unless the local market enables multiple plants. Localization of ground works, municipal connections, construction work phases, and part assemblies on-site can be considered
11	Use of European standards?	RR SMR will be designed to the ASME standard for components with high quality & safety requirements. For other components the European Harmonised standards will be applied.	The countries in Europe that are indicating demand for the BWRX-300 recognize ASME, IEC, ASCE and AISC , which are the primary standards applied to the BWRX-300 standard design. For different codes and standards, GEH and its partners have experience performing equivalency evaluations.	Mainly AFCEN codes are used in conceptual design. Specific technical referential may be needed for certain CSGs. Codes & Standards selected must be compatible with national regulations & mastered by key stakeholders.	European codes & standards will likely be used for LFR deployment in Europe. ASME III & RCC codes are expected to be leveraged. The LFR demonstrator is designed within ASME Code limits, but code cases may be needed for accidents or high-temp. applications.	The ALFRED design and safety criteria are built up from IAEA and EUR standards, and other widely accepted design codes and standards in Europe (e.g., ASME, IEC, AISC, Eurocode), while considering also future harmonization with other standards to maximize the width of the supply chain spectrum (in particular, RCC-MRx).	Intention is to use European Pressure Equipment Directive for the main guideline for the pressure equipment. Simplicity of the design can be adapted to evolving Codes and Standards. Application of ASME or RCC-M codes for class 1 nuclear components to be studied and if mandated by customer/regulator.
11 b	Need for new standards?	No need.	The existing codes and standards cover the all aspects of the BWRX-300 except for the use of steel concrete composites (SC) for the containment and a few other minor aspects. GEH currently has an ASME code case underway for inclusion of SC for containment.	Still under study and to be defined.	Codification of new material (alumina-forming austenitic stainless steel) may be required.	Materials development, coating industrialization and qualification of prototypical components may lead to code cases for nuclear design codes.	No need.